

*What is claimed is:*

1. A non-invasive corrosion sensor, the sensor to detect corrosion on a test piece, the non-invasive corrosion sensor comprising:
  - a. a heat sink;
  - b. a peltier, the peltier having a first side and a second side, the peltier communicating with the heat sink such that the first side of the peltier is maintained at a common temperature;
  - c. a reference standard, the reference standard and the test piece communicating with the second side of the peltier; and
  - d. a data acquisition devise, the data acquisition devise able to record and compare the differences in temperatures of the test piece and the reference standard.
2. The non-invasive corrosion sensor of claim 1, wherein the non-invasive corrosion sensor further comprising an enclosure, the heat sink, the peltier, and the reference standard disposed within the enclosure.
3. The non-invasive corrosion sensor of claim 2, wherein the enclosure is manufactured from polycarbonate.
4. A non-invasive corrosion sensor, the sensor to detect corrosion on a test piece, the non-invasive corrosion sensor comprising:
  - a. a heat sink;
  - b. a peltier, the peltier having a positive side and a negative side, the peltier communicating with the heat sink such that the negative side of the peltier is maintained at a common temperature;

- c. a reference standard, the reference standard and the test piece communicating with the positive side of the peltier;
- d. a data acquisition devise, the data acquisition devise able to record and compare the differences in temperatures of the test piece and the reference standard; and
- 5 e. an enclosure, the heat sink, the peltier, and the reference standard disposed within the enclosure.

5. A non-invasive corrosion sensor, the sensor to detect corrosion on a test piece, the non-invasive corrosion sensor comprising:

- 10 a. a heat sink;
- b. a reference peltier and a test piece peltier, each peltier having a positive side and a negative side, each peltier communicating with the heat sink such that the negative side of each peltier is maintained at a common temperature;
- c. a reference standard, the reference standard communicating with the positive side of the reference peltier, the test piece communicating with the positive side of the test piece peltier;
- 15 d. a data acquisition devise, the data acquisition devise able to record and compare the differences in temperatures of the test piece and the reference standard; and
- e. an enclosure, the heat sink, the reference peltier, and the reference standard disposed
- 20 within the enclosure.

6. The non-invasive corrosion sensor of claim 5, wherein the enclosure is manufactured from polycarbonate and environmentally sealed with flowable RTV silicone coating.

- 25 7. The non-invasive corrosion sensor of claim 6, wherein the test piece and the reference standard are manufactured from the same material.

8. The non-invasive corrosion sensor of claim 7, wherein the heat sink is manufactured from aluminum.

5           9. The non-invasive corrosion sensor of claim 8, wherein the reference standard is polished to remove all surface corrosion and contaminates and is sealed.

10. The non-invasive corrosion sensor of claim 9, wherein each negative side of each peltier is bonded to the heat sink with thermal epoxy.

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11. The non-invasive corrosion sensor of claim 10, wherein the thermal epoxy is a Zinc-Oxide/Silicon based grease.

12. The non-invasive corrosion sensor of claim 11, wherein the thermal grease is about 60 to  
15   about 80% zinc oxide with dimethyl polysiloxane, silicone fluid and polymethylsiloxane.

13. The non-invasive corrosion sensor of claim 12, wherein the thermal grease has a specific gravity of about 2.2, its solubility in water is negligible and has a flashpoint above 250 degrees Fahrenheit.

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14. The non-invasive corrosion sensor of claim 13, wherein each negative side of each peltier is bonded to the heat sink with thermal epoxy.

15. The non-invasive corrosion sensor of claim 13, wherein the positive side of the reference  
25   peltier is bonded to the reference standard with thermal interface material.

16. The non-invasive corrosion sensor of claim 14, wherein the positive side of the reference peltier is bonded to the reference standard with thermal epoxy.

17. The non-invasive corrosion sensor of claim 14, wherein the positive side of the reference  
5 peltier is bonded to the reference standard with thermal interface material.